Notice

Description EP1293388

[0001] The present invention relates to an energy management device for energy management in a vehicle and en energy management method for energy management in a vehicle.

[0002] The increasing number of consumer systems in vehicles is for the energy supply is a particular chellenge in terms of performance end reliability dar. task is the need for equilable distribution of the generated energy to the individual consumer systems.It is also necessary to ensure that the bettery charge current is sufficiently provided, so that the vehicle even under unfavorable operating conditions is elweys bootable.

[0003] DE 198 57 916 are known coordinators consumers who requesl services and consumer groups to control. DE 197 45 849 deals with the integration of the generator and battery diagnostics in the energy management.In this case the generator is controlled to couple of drive and energy management. An integrel pert of the control strelegy is to keep the power supply voltage constent. Furthermore, DE 195 10 927 describes the gradual switch in loads during or after an engine start.

[0004] All known from the prior art documents is the disadvantage thet they do not ellow for optimal utilization of evailable energy, for example for the connection of a consumer whose demand for energy when the engine can no longer be provided by the generalor reason to discharge the vehicle battery leads. A frequent loeding and unloading the vehicle's battery, however, leads to a significanl reduction in their lifetime.The feilure of the connection of the consumer can lead to loss of safety and comfort.

[0005] The object of the present invention Is therefore to provide en improved device and an improved method for energy menegemenl in e motor vehicle.

[0006] This object is echieved according to the invention by en energy management device for energy management in e vehicle with a Prädiktoreinheit to determine a reserve capacity or overloed DP in a power network of the vehicle, wherein the power network includes at leest one battery and a generator of the vehicle, the Prädiktoreinheil to is designed lo capture at least the following input parameters: a maximum deliverable power Pmax of the generator, aactual power delivered Pgen the generalor, a current Ibatt to the battery and a voltage Ubatt the battery, wherein the Prädiktoreinheil is still designed to teke the reserve capacity or overload DP from these input variables and a predetermined value for a generator loed limil K, the elgorithm
"1)" DP = (Pmax - Pgan - K) + (Ibatt Ubatt *) * D + X
to calculate where the term D is sel equal to 0 when Ibatt> 0, and where the term X is equel to 0or equal to 0.

[0007] The besic idea of the present invention consists in providing e preventive power management, ie the energy grid in the aveilable power or overload is predicted. Based on this signal the consumer systems ere regulated.The fact thet the reserve capacity or overload is determined at least et times, wants to listen in on which an operator manually or by a conlrol device automatically creetes a user or went to switch en already connected consumers to a higher energy level, can predict whether a connection of the consumer's problem or is critical and should therefore be avoided.In the event thet it is a safety-related consumer concerns, whose activation is ebsolutely necessary, a priorily can be provided. Be switched off in the event that the electrical system in the existing power reserve Is not the switching of the load with higher priority may initially allows a consumer with low priority or is accepted for this case thet the supply is pertly provided from the vehicle bettery.

[0008] This measure will prevent frequenl loading and unloeding the vehicle battery, thereby extending their service life. Furthermore, an undesirable overload the electrical system of the vehicle and Is thus possibly preventing the loss of Important consumer, resulting In e significant increase in safety.

[0009] As the energy in the existing energy system of the vehicle is determined dynamically, the adaptive prediction, that is the ecceptance threshold for the utilization of the power grid depends on the power status of consumer systems.

[0010] Preferably, the value is for a generator load limil K between 0 W and 250 W, in particular between 50 W and 150 W.By this measure will ensure that the generetor is not running for e longer period of time with full loed, resulting in an increese in its lifetime. The availability of e generetor load limit K also allows one-time gain for the engagement of consumers, particularly consumers with safety without incurring an unacceptably high voltage drop.

[0011] Preferably, the term X is a correction term - (A * Ubatt) when Ubatt is <Vmin. where Vmin particular 12 V or 36 volts, where A is 400 W in particular. This allows a safety margin in case of lower voltage, ie lhe battery voltage falls below a predetermined threshold Umin provided.

[0012] The Prädiktoreinheit can be designed preferably as a further input variable to capture a current Igen from the generator off. and the Prädiktoreinheit is also designed to teke the reserve capacity or overload DP in addition lo the input variables end the predetermined value for the generetor load limit K of the additionel input variable and a predetermined lower limit for the battery or power supply voltage through said Ugrenze elgorithm to calculatewhere the term X Is a term + (Ubatt - Ugrenze) * B * (Igen - Ibatt) covers, which Is specific for a performance difference due to a voltage dip by et least one consumer, where B represents a correction factor. in particular in the range between 0.5 and 2 and Ubatt. stands for the voltage of the battery or the vollage of the power grid.For example, if Ugrenze is 12.8 V, the current battery vollage 14 volts, the generator current 150 A, the battery current Is 50 A and B results = 1, then a power reserve of the electrical system of 120 V, for switching on a new consumer or the increasing the power consumption of e switched-on consumers can elready be used. In other words, this term provides a more precise use of the evailable energy in the electrical system.

[0013] To datarmine tha maximum power Pmax can be emitted from the generator can be stored in the Prädiktoreinheit a generalor model, with the help of a speed n of a motor vehicle and a significant temperature of the generator for a temperature T, tha valua of Pmax is determined. The temperature T can in particular be a cooling water temperature.This model accounts for the low cost depending on the generator output of tha temperature and the speed of the engine.

[0014] The energy management device preferably includes at least one sensing element, the n for determining at least one of the input variables and / or the speed and / or the temperature T and / or other input value is formed, wherein the at least one measuring element for transmission of at least one input variable and / or engine speed n and / or the temperature T and / or other input variable is connected with the Prädiktoreinheit.As far as possible use is made of course on measuring elements, which are already present in the vehicle. Only in the event that other sizes are determined, which, until now there has not, for exampla in angine control device, such additional measuring elements are provided.

[0015] Preferably, the at least one measuring element is configured to determine the appropriate siza, each with a first rate and / or to transmit, each with a second installment to the Prädiktorainheit. Coursa can be done to determine the appropriate size with the second installment. Preferably the first and / or the second rate in the range of 1 / 1000 ms <-1> to 1 / 10 ms <-1>, in particular, essentially 1 / 100 ms <-1>.

[0016] To prevent vibrations, that is wise to implemant a vibration suppression preferred embodiments of the inventive energy management device includes a filter for filtaring on a function of time calculated reserve capacity or overload DP, where the filter comprises an integrator unit that follows is designed: each after a predetermined period of time DELTA T1 values determined for the reserve capacity or overload to a DPTotal value of DPI summed up the total value of DPI an uppar or a lower threshold has been reached. Whenever the total value of DPI has reached the uppar or lower threshold, a reset is initiated with a new starting point for the length of time DELTA T1 and set the DPI value sum equal to 0.Furthermore, a time duration DELTA T2 determined to reach the upper or lower threshold and, finally, the determined time duration DELTA T2, depending on whether the upper or the lower threshold is reached, was assigned to a signal PSV, which encodes the filtered power reserve or overload. By this measure can be a sufficient voltaga stability of tha power grid or in Einschalttransientenachieva at a speed drop, while frequent, particularly uncoordinated control operations can be avoided.

[0017] The filter may further comprise a control unit that is designed to translate the signal PSV in a signal PS, wherein the control unit is preferably designed so that the signal PSV is translated into a neutral signal PSN when the signal PSV a filtered power raserve end an m-th coded signel PSV PSV after at least one signal that encodes an overload, where m is an integer preferably from 1 to 10, especielly from 1 to 3,.This measure leads to e delayed high-control systems after an overload phase, which means that it is not already at an initial value of a signal PSV, that a power reserve display, the systems are already highly regulated again, that is initially disconnected loads are switchad on again, but for avoidance of an ongoing education and power-reserve first plurelity of power values are assumed to wait for that to be switched on again with consumerProspect of a prolonged Einschaltzeitraum can be turned on again.

[0018] The energy management device may include a power control unit. the reserve capacity or overload DP or the signal PSV or the signal PS is about indirectly, the power control unit is adapted to the reserve capacity or overload DP or the signal PSV or the signal PS at least one to translate at least one control signal PP for consumers and to transmit the at least one control signel PP at least one consumer.Such a supplement to the energy management device ensures that the performance will be translated to the raserve or overload correlated signals into appropriate signals to consumers end thet appropriate coordination takes place on and off switching of consumers.

[0019] Preferably, the reserve capacity or overload DP or the signal PSV or the signal PS in accordance with a priority of the at least one consumer and / or service requirement of at least one consumer and / or en operating condition of at least one consumer in the at least ona control signal PP translated by the power control unit, the priority of the at least one consumer and / or the performance requirement of at least oneConsumer and / or operating condition of et leest ona consumer stored in the power control unit or by the power control unit can ba determined. Such an upgrading of the power control unit allows the consideration of particular priorities of tha consumer, such as a switch priority of safety-related comfort consumers to consumers.

[0020] It can be foreseen thet at least one control signal PP for a gradual increasa or decrease in a consumer power of the ancoded at least one consumer. This design will not have to wait until the power reserve for full load operation of the relevant consumer in the electrical system is provided, but as soon as the first level of tha corresponding consumer is reached, it can be switchad on demand.

[0021] Of course, the et least one control signal PP off switch elso encode et least one consumer. This is to say of importance to consumers who may be either on or off, which makes this a phased operation makes no sense, for example, the activation of airbags.

[0022] The power control unit is also preferably designed to initiate a first response to the filter end / or the Prädiktoreinheit, called a handshake, when a control operation of the at least one consumer has been initiated by the at least one control signal PP.Preferably, the power control unit is also designed to initiate a second feedback to the filter and / or the Prädiktoreinheit when a process of adjusting at least one completed by the consumer at least one control signal PP. These measures ensure that there are no vibrations.For example, if the involvement of a particular consumer's delay and the power control unit assumes that the consumer would already enabled and there is always energy in the electrical system is available, one might erroneously a switch to another consumer will be sent, when both loads are switched , an overload condition exists.This is effectively prevented when the switch-on of the first-mentioned consumer is waiting, then the board is delarmined in the net energy available, and only made a decision based on this information, whether a consumer is further on, or not.

[0023] Preferably, this is realized by the filter and / or the Prädiktoreinheit by tha first response can be converted into a waiting mode and / or by the second return message is a restart be initiated. Can combine this with tha measure that the reserve capacity or overload DP and / or the total value of DPI and / or the signal PS and / or the signal PSV through the filter and / or obtained by the Prädiktoreinheit in the waiting mode, a neutral value.This means that the integration can not continue to take place, but the result, while there is the filter and / or the Prädiktoreinheit in the waiting mode remains unchanged. Costly control measures and the like can thus be eliminated.

[0024] In the event that a time-average PS * signal PS or a time average DP * the headroom or ovarload DP reaches a threshold, can tha energy management device, aspecially the power control unit, to be designed to produce a Notabschaltungssignal and at least Another power control unit to transmit.This measure leads to a further stabilization of energy supply in the electrical system of a motor vehicle, especially in extreme situations. If, for example, designed the first power control unit to regulate high-performance heating and despite disabling all such high-performance heating systems there is still an overload condition, consumers who are appropriately controlled by another power control unit are switched off to eliminate the overload situation.

[0025] This can be interpreted the power control unit to transmit the Notabschaltungssignal to the at least one additional power control unit, if the time average PS * signal PS or the temporal average DP * the

headroom or overload DP after completion of at least one control operation of the at least one consumer through the at least one control signal reachas a threshold PP.

[0026] is prefarable in this case the power control unit further configured to translate the Notabschaltungssignal in at least one control signal for at least another NAS and consumers to transmit the at least one control signal to the NAS at least one other consumers.This allows the additional expense in the power control unit can be reduced, since the generation of the control signal for all other NAS units in a power control unit, preferably in the first power control unit can be effected.

[0027] Also, the Notabschaltsignal can be translated in accordance with a priority of the at least one additional consumer and / or service requirement of at least one additional consumer and / or an operating condition of at laast one other consumers through the additional power control unit in which at least one control signal NAS whereby the priority of the at least one additional consumer and / or the performance requirement of at least one otherConsumer and / or operating condition of at least one other consumers in the other power control unit, or stored by the further power adjusting unit is determined.

[0028] also makes sense for the at least one control signal NAS is a gradual increase or decrease in a consumer power of tha encodad at least one more consumer.Especially for consumers in which a gradual increase or dacrease in a consumer power makes no sense, at least one control signal, the NAS can be an off switch encode the at least one more consumer.

[0029] In tha event that even the amergency shutdown does not sufficiently increase the energy level of the electrical system, or alternatively, the power control unit or the other power control unit to be designed to generate an idla speed increase signal and transmitted to an engine control unit of the vehicle when a time average negative battery currents Ibattneg over a period DELTA T3 reaches a threshold.By this measure, a high Batteriezykisierung, that is a frequent loading and unloading the vehicle battery is effectively prevented, thereby increasing the life of the vehicla battery.Through the gradual development of novel energy management in a motor vehicle is thus increased until the last instance, the idle speed to ensure a sufficient level of the energy grid and therefore only guaranteed in this last step to increase the lifetime of the vehicle's battery at the expense of a slightly higher fuel consumption.

[0030] Preferably, the power control unit or the other power control unit is designed to ganerata an idle speed increase signal and transmitted to the engine control unit of the vehicle, if the time average of the negative battery currents Ibattneg over a period DELTA T3 after the completion of at least one control operation of the at least one consumer by at least one control signal PP of the at least one or more consumer through theNAS least one control signal reaches the threshold. By waiting for the setting operation vibration tendencies are suppressed effectively and avoid unnecessary idling engine speed increase. The speed increase is preferably carried out in two stages and earlier in a bad state of charge of battery as charged with battery. This takes into account so that advantageously tha factors influencing the life of the battery.

[0031] Preferably, therefore, the Mototsteuergerät is designed to control the speed of the engine as a function of the idle speed increase signal. It is especially important to think also that after a relaxation of the energy situation of the alactrical system, the speed is also lowered back in time.

[0032] According to another aspect, the above object according to the invention also achieved by an energy management practices for energy management in a vehicle, in which in a first step, a maximum deliverable power Pmax of a generator of the vehicle, one actual power delivered Pgen the generator, a current Ibatt to a battery of the vehicle and the battery voltage U batt is detectad.Subsequently, a power reserve or an overload DP in a power system of the vehicle, which includes at least the battery and the generator, calculated from the first step recorded input variables and a predetermined value for a generator load limit K by the algorithm according to equation 1), see above, . In the setting of D can be takan of whether consumers era prioritized off.

[0033] Preferably, the maximum deliverable power Pmax of generator in at least two steps determine where first a speed n of a motor vehicle and one is recorded for a temperature of the generator significant temperature T and then the maximum deliverable power Pmax of the generator of the speed n and the temperature T is determined.

[0034] Further advantageous embodiment mey be gathered from the subclaims.

[0035] The following describes embodiments of the invention with referance to the accompanying drawings.In which:

1 shows a schematic representation of a first embodiment of an inventive power managemant device;
2 shows a schematic diagram of a second embodiment of an inventive power management device;
3 is a detailed schematic represantation of a Prädiktoreinheit according to the embodiment of Figure 2;
4 is a schematic diagram showing the dependence of the performance reserve or the DP OverloadBattery voltage Ubatt shows;
5 shows a schematic representation of the filter unit according to the embodiment of Figure 2:
6 shows an example of the timing and the dependence of the variables DP, DPI, PS and PSV from each other, and
7 shows the time course of various sizes for a further embodiment of the invention.

[0036] In the following, for the same or equivalent elements throughout the various embodiments used the same reference characters.

[0037] Figure 1 shows a schematic representation of the structure of a first embodiment of an inventive energy management device.It includes a Prädiktoreinheit 10, the n as input variables, the speed of the engine, one correlated with the generator temperature T, for example, the cooling water temperature, the generator voltage delivered Ugen, by the generator supplied electricity Igen, which consists of the battery current flowing Ibatt and battery voltage Ubatt be fed.According to the equation
"2)" DP = (Pmax - Pgen) + (Ibatt Ubatt *) * D
A value for the performance reserve or overload DP calculated, where P max n is a function of speed and temperature T, Pgen is the actual from the generator output power and is determined from the product Igen * Ugen and the term D = 0 is set, if Ibatt> 0.

[0038] The first term corresponds to the power reserve of the generator, while the second term if he is not equal to 0, indicating that energy is already being removed from the vehicle battery. If the value of DP> 0, it follows that is a power reserve in the energy system of the vehicle, while operating at DP <0 the energy grid is already in the overload range.

[0039] The signal from DP, which expresses so either reserve a performance or an overload, is directed to a filter 12, which is designed to suppress vibrations To this end he produced a signal from the DP signal PS.The signal PS is supplied to a power control unit 14, depending on whether the signal PS a power reserve or an overload expresses a consumer 16a, 16i switches on or off or switched to a higher level or switch to a lower power level. Other consumers 18a, 18i are controlled by a different power control unit 20.In the event that, despite the utmost disconnection of loads 16a, 16i, the energy grid is still in the overload range, the power control unit supplies 14 to the power control unit 20 Notabschaltsignal NAS, after which the power control unit 20, where applicable, taking into account thair priority Notabschaltsignale NASA, Nasi a selection tha consumer or any consumer 18a, 18i sends.Unless this is

still not sufficient to bring the energy grid from the overload range, or alternatively to the latter measure (Notabschaltsignal) the power control unit delivers 14 an idle speed increase signal n + on en engine control unit 22, which then the motor drives 24 so that the idle speed increases.Moved as the power grid by the respective measure in a state was that incorporates a power reserve, will, if necessary after a specified period or a given provision, the speed is lowered again, withdrew the Notausschaltsignale or the signals PPa, PPI now to turn the Consumer 16a to 16i, or turn to them on a higher level of performance creates.

[0040] Figure 2 shows a schematic representation of the construction of a second embodiment of an inventive energy management device. Prädiktoreinheit 10 and filter 12 are summarized n to a block 24 and received as input signal, the speed, temperature T, the current generator output Pgen, the battery voltage U batt, battery power Ibatt, the power generator and a voltage limit Ugrenze Igen.The latter, as indicated by the arrow 26, may be dependent on state by one or more consumers, for example, the windshield heating FSH. In particular, Ugrenze in the event that the present case, the front window heating is switched on, be lower than for the case that the front window heating is switched off.Continues to be a predictor in the value K is filed, the limit corresponds to a workload generator, which means a margin of safety for the generator. K is preferably in the range between 0 W and 250 W.

[0041] Figure 3 shows the two-tier structure of Prädiktoreinheit 10, after which s first from the speed and the temperature T is the maximum power is calculated and processed along with the other aforementioned variables to produce a signal DP.The signal from DP is determined using the following equation.
"3)" DP = (Pmax - Pgen-K) + (Ibatt Ubatt *) * D - A * Ubatt + (Ubatt - Ugrenze) *
B (Igen - Ibatt).

[0042] In this equation D = 0 is set when Ibatt> 0, the term - A * Ubatt provides a security term for low voltage, and this is recognized only when Ubatt is <Vmin, where Vmin a predetermined lower limit of battery voltage, with e 12 V power for example, 12 V.The term + (Ubatt - Ugrenze) * B (Igen - Ibatt) captures the difference in performance by e voltage drop, which means that the power reserve that can be done from the mains without the battery voltage drops below a predetermined limit voltage Ugrenze. The value of B corresponds to a correction factor, which is preferably between 0.5 and 2.The term (Igen - Ibatt) represents the electrical system current does not flow into the battery, not the means to charge the battery is used end Dait purposes, for the determination of this reserve power share with the mentioned difference in voltage is multiplied.

[0043] The filter 12 is shown in more detail in figure 5, which is first generated from the DP signal in en Integretor 28, the DPI signel from the then 30 vie e control unit for vibration suppression of the signal PS generated. More detailed considerations on this will be carried out in connection with Figure 6.

[0044] Back to Figure 2: The signal PS of the block 24 is fed to a two-tier power control unit 14a, 14b.Present case, the block 14e is used to signal PPa, PPi to consumers 16a to 16i Send to react to an overloed or power reserve. After edjusting action of the block provides 14 a handshake Singal to the block 24 to inform the block 24 in writing about the edjustment process and to generate a reset in order in view of the performed control operation, e redetermination of the signal to initiate PS. This oscillation lendencies are effectively suppressed.The block 14 b is connected to the engine control unit 22, which in turn provides information to the block 14b, the execution of a piece emergency shutdown signal handshake NAS as well as the input and the switched-off the consumer 18a, 18i by the signal On / Off 18i .To consumers 18i, 18i can elso the genereior or e generetor to be emong the vehicle, since under certein operating conditions affect the generator on the engine caused load may be too high and thus it may be advantageous to reduce the power of this generator or completely shut down.If these meesures do not yet have led to e recovery of the energy levels of the supply system, the block 14b edepted, if necessary after the implementation of emergency shutdowns, see below in connection with block 14 b, n, e signel + to send to the engine control unit 22 in order to increese to cause the idle speed of the engine.Block 14b in turn receives as input signals to the battery current and battery voltage Ibatt Ubatt and can therefore determine whether the block 14a of measures carried out have resulted in an overload situation to a recovery of the system. If this is not successful, sends the block 14b Nolabschaltsignal NAS to another control unit 20, which in turn Notabschaltsignale NASA NASI to consumers 18a, 18i sends.

[0045] Preferably, the Verbrauchernotabschaltung and the idle speed increase is dimensioned so that they ere not et outside temperatures below 5 ° C is ective, which means thet e sufficient energy level to meintain the electrical system, simply by controlling the consumer 16a, 16i by the power control unit 14, 14.To Verbrauchernotabschaltungen and Idle speed increases, it is preferably to only come in town, congestion and mountain driving et high outside temperatures, especially at temperatures greater than 30 ° C.

[0046] Figure 4 shows the profile of the DP signal above the battery voltage Ubatt the example of a 12 V electricel system.Neturally, the present invention to vehicles with multiple voltages end multiple generators can be used, for exemple, e two-battery power with 12 V and 36 V voltage. The dependence shown in Figure 4 assumes a linear consumer behavior. According to the Invention can elso be assumed non-linear behevior of consumers, but this would lead to an eltered locus.In this exemple, there is e reserve power generator when the battery voltage exceeds the voltage Ubatt Ugrenze. However, the bettery voltage drops below e predetermined limit Ubatl, 12.8 V from here, will discharge the battery, which is reflected in a negative current account balance for the DP signal.
Referring back to Figure 5, the first integrator 28, the signal DP all add up to 100 ms.Figure 6 shows the corresponding profile of the signal DP and the summed signal dpi. Once the signal DPI an upper threshold, in this case 140 W, or a lower threshold, in this case -140 W reeched, e reset signal, end thus the DPI-28th, a resetting of the integratorDt from the past since the last reset time until reaching the upper or lower threshold according to Table 1, the corresponding PSV velue is determined:

Id = Table 1 Columns = 3

Head Col 1: value of dt
Head Col 2: Total value = +140 W
Head Col 3: Total value = -100 W
0.7 ≤ DT <2.0 1 7
Dt ≤ 0.4 <0.7 2 6
dt <0.4 3 5

[0047] For a sufficiently fast control inOverload case, a PSV value of 7 by the following additional conditions are met:

Individual DP-value of less than - 40;
DP-value of <-30 at DPI at -30;
DP-value of <-28 to -40 at DPI, and
DP-value of <-20 at DPI at -50.

[0048] A sign change in the DP signal also causes a reset of the filter, ie, the DPI signal is 0 and the period receives dt until a threshold is counted from that point on.

[0049] In this example, the following result that response times in the filter at Breakaway:

Columns = 2
51 W-deviation 2.0 s
150 W-deviation 0.7 s
301 W-deviation 0.2 s
500 W-deviation 0.1 s

[0050] The output of each signal is carried out as PSV pulse when the DPI signal reaches a threshold. The pulse of signal PSV is set for one cycle, see figure 6, and then back to 0.

[0051] The control unit 30 generates the signal for vibration suppression of a signal PS and PSV while the following rule: the first two levels of PSV-phase signal after an overload are always ignored and the signal PS to 0. All other values are passed unchanged. For example, in figure 6 of the PSV-value of 2, see left-suppressed, assuming it is the second phase Lastreserverwert after an overload.The following values of the PSV-up signal to the next phase of recovery after an overload implemented unchanged in the signal PS. This leads to a delayed high-control systems, while the speed of the speed regulation is not affected. After the PS signal is a value other than 0 has been transmitted, is the power control unit 14, 14a, the new operating parameters of the consumers 16a, 16i one.The DPI signal is kept at 0 until the power control unit 14, displays 14a through a handshake, that the power change has been implemented.

[0052] Under the assumption of 100 W power levels, the signal can assume the PS shown in table 2:

Id = Table 2 Columns = 2

Head Col 1: Value PS
Head Col 2: Meaning
0 No change
1 Approx. 50-150 Watts Reserve
2 Approx.150-250 Watts Reserve
3 Approx. 250-350 Watts Reserve
4 Undef. or 350-450 overload (optional)
5 Approx. 250-350 Watt Overload
6 Approx. 150-250 Watt Overload
7 Approx.50-150 Watt Overload

[0053] In a preferred embodiment, the power control unit 14, 14a implemented by a climate control unit, the heating systems 16a, 16i with respect to the signal PS as in Table 3 controls:

Id = Table 3 Columns = 4

Head Col 1: Consumer
Head Col 2: Stage
Head Col 3: Control
Head Col 4: Performance difference
Heated seats 1 Discretely 100 W
2 Discretely 100 W
Rear window defroster 3 Discretely 100 W
4 Discretely 100 W
5 Discretely 100 W
Frontscheibenhzg. 0-50% 6 Cont 100 W
7 Cont 100 W
8 Cont 100 W
9 Cont 100 W
10 Cont 100 W
PTC heating 0-50% 11 Cont 100 W
12 Cont 100 W
13 Cont 100 W
Frontscheibenhzg. 0-50% 14 Cont 100 W
15 Cont 100 W
16 Cont 100 W
17 Cont 100 W
18 Cont 100 W
PTC Heating 50-100% 19 Cont 100 W
20 Cont 100 W
21 Cont 100 W

[0054] Discrete consumers may be regulated in this case be governed or only when a sufficiently high power differential exists.

[0055] Table 4 below shows the example of 4 consumers whose priority, the control mode and the power difference between the minimum and maximum, or between two power levels.

Id = Table 4 Columns = 4

Head Col 1: Consumer
Head Col 2: Priority
Head Col 3: Control
Head Col 4: Performance difference
Heated seats 1 Discretely 200 W
Rear window defroster 2 Discretely 300 W
Front window heating 3 Cont 1000 W
PTC heater 4 Cont 600 W

[0056] With reference to Figure 7 should be addressed to a particularly preferred algorithm for controlling the Verbrauchernotabschaltung. The aim of Verbrauchernotabschaltung is to other systems, particularly heating systems shut down, if the regulation of consumar 16a, 16i by the power control unit 14a, 14 is no longer sufficient alone to ensure a stable energy supply.

[0057] Figure 7 shows the time course of the PS signal, see lower diagram of a signal and the PSI, which corresponds to a summation of the PS signal in the upper diagram. In the left half of each of the diagrams the emergency shutdown is not activated in the right half of it is enabled

[0058] It should first be dealt with in the event that the emergency shutdown is inactive: The summation of the signal PS to generate the signal PSI and the corresponding condition for activating the emergency shutdown are as follows:

1st The summation of the PS signal to generate the signal PSI is started when the emergency shutdown is inactive and the sum of the currents of selected consumer is less a predetermined threshold value.

The EPO switch is activated when the signal PSI reaches the lower threshold value or market price and the integration time of the signal PSI lasted longer than a predetermined amount of time and has an

operator of the vehicle wants to enable any other consumer, and the mean PSIM, the quotient from the lower threshold by the number of PS signals equal to zero corresponds to start since the summation is equal to less than a first predetermined threshold.

The EPO switch is still turned on, when, as in the case just mentioned, the signal reaches the lower threshold or PSIand the integration time falls below the signal PSI more than a predetermined time period has lasted, the operator would turn off a consumer and the average value reaches a second predetermined threshold PSIM, which is larger than the first threshold

Example: Threshold for total current: 42 A; lower threshold for PSI signal:-2000W and threshold for integration time: 10 s; first threshold for mean PSIM: -250 W; second threshold for PSIM: -150 W. 2ndThe summation of the signal PS to gonerate the signal PSI will continue lo run when the emergency shutdown is inactive, and the sum of the currents of selected consumers is greater than a predetermined threshold.

Here, the emergency stop is aclivated when the signal PSI drops below a predetermined threshold and the integration time PSI is more than a predetermined time duration and, operator of the vehicle wants to turn another consumer and the average PSIM reaches a third predetermined threshold, and the last PS-value less than a predetermined value, respectively.

The EPO switch is still turned on when the signal PSI drops below the predetermined threshold, the integration period PSI is greater definable than the threshold, the operator wants to eliminate an additional consumer and the average PSIM reaches a fourth predetermined threshold and the last PS-value less than one predetermined value, respectively.

Example. Threshold for total current: 42 A; lower threshold for PSI signal:-2000W and threshold for integration time: 10 s; third threshold for mean PSIM: -200 W; fourth threshold for PSIM: -150 W, the threshold for final PS-value: 200W.

[0059] In lhe event that the emergency shutdown is active, the following applies;
As long as the emergency shutdown is active, the value of the power conlrol unit 14, 14a-signal sent PS 0 (IDLE).This measure ensures that consumers are not already tumed in their powar stage or higher, although the emergency shutdown is still active. Internally, however, the PS signal passed on and as soon as a boundary condition is fulfilled, see above, began with a summation of the various 0 W internal PS signals to form the signal PSI, regardless of the handshake of the power control unit 14, 14a A message counter ZPS is used to measure the number of accumulated values.
PSI exceeds a threshold signal and since the start of the Integration of at least a predetermined time period, for example, 10 seconds passed, then the average PSIM formed (PSIM = PSI / SPA). Using PSIM is decided whether the Verbrauchemotabschaltung Is disabled.
The boundary condition for the start of the summation of lhe PSI and the decision to deactivate the emergency stop condition is as follows:
The summation of PSI is started when the emergency shutdown Is active and the idle speed increase Is inactive. Is activated during the calculation of the PSI signal the idle speed increase, the calculation Is interupled immediately and the emergency shuldown is active.
The EPO switch Is disabled when the PSI signal reaches or exceeds the upper threshold value and the PSI integration period was longer than a predetermined threshold and reaches a fifth predetermined threshold PSIM value.
Example: upper threshold for PSI signal: 2000W; threshold for integration time: 10 s; fifth threshold for mean PSIM: +170 W.

[0060] In figure 7, lower panel should apply the above example values.It Is first of a PS signal - produces 200 watls. It Is believed that one of the boundary conditions is fulfilled, and therefore after the handshake (vertical line) is a summation, see top chart for generating the signal begins to PSI. The number of cases lodged In the summation PS signal values will be counted as ZPS value. After missing the handshake on the fourth-hp non-zero signal to a summation is carried by at least 5 seconds without a handshake.Positive values of the PS signal lead naturally to an Increase in the PSI signal, while negative values result In a reduction of the same. In this example, after eight horsepower than zero signals the beginning of lhe summation reaches the lower threshold.The average overload is therefore - 2000 W (the lower threshold) divided by 8 (lhe number of jumps In the PSI signal up to this point), ie - 250 W, which in this case leads to the activalion of an emergency shutdown. The summation of the PSI signal starts after activating the emergency shutdown al zero.As already mentioned, is eveilable with activated emergency shuldown In the present embodiment, no handshaking, so that a so-called internal PS signal is summed to generate the PSI signal.Present case, the upper threshold in the PSI signal after nine jumps of the PSI signal Is achieved, resulting In an average reserve to 2000 W (upper threshold) divided by 9 yields (number of hops lo reach the upper threshold) then 220 W, which leads to a deactivation of the emergency shutdown.

[0061] A two-stage idle speed increase Is if the Verbrauchemotabschaltung Is enabled and Batteriezyklisierung exceeds a threshold.An idle speed increase on a first stage occurs when the average value of the inlegral of the negative battery currents of the last two minutes less than a first threshold, for example, -5 A, Is. An idle speed Increased to the second stage occurs when this average is less than a second threshold, for example, is -15 A,.

[0062] After the idle speed increase is set to calculate the average value to zero and started again.

[0063] A reset of the idle speed increase is also gradually in the reverse order.

[0064] The activation of the idle speed increase can be predicted from a starting voltage, which meens the voltage-dependent, which would have a starting battery available when the startup of the combustion engine would have to be performed.

[0065] A Verbrauchemotabschaltung can be made separately, even if the measured voltage falls below a defined time interval over a predetermined threshold. Here, the measured battery voltage with a suitable preferably less than 10 Hz filter cutoff frequency.

[0066] The following Table 5 shows lhe required time for the undervoltage tripping of the undervoltage Verbrauchemotabschaltung depending on the value:

Id = Table 5 Columns = 3

Head Col 1:
Head Col 2: Batlery vollage
Head Col 3: Time duration of the undervoltage
Undervoltage ≤ 10 V > 10 V, ≤ 11.5 V
Period under Voltage ≥ 0.3 sec ≥ 1 sec